spicuous, namely, the attempt, wherever practical, to illustrate the conclusions by diagrams or by appeal to experiment. Prof. Webster is a firm believer in both the analytical and the geometric method, and he rightly emphasises the importance of Lagrange's monumental work, in which there are no figures, but only algebraic equations. But *in the interpretation of results* the geometrical method is often the most fruitful, and it certainly appeals best to the reader who, like Prof. Webster, regards geometry as a physical subject. Possibly it is not so generally known as it ought to be that one important branch of dynamics, namely, uniplanar rigid dynamics, can be treated practically without the use of analysis by drawing diagrams for each problem, and inserting a force, Ma, at the centre of each mass, and a couple, $Mk^2d^2\theta/dt^2$, about that centre. Be this as it may, the curves illustrating the motions of tops, the compounding of oscillations, and similar problems convey much more meaning than a mere formula.

The book consists of three parts. The first deals with general principles and applications to systems of particles. It contains the principle of least action, the theory of free and forced oscillations for finite systems, and a short account of the theory of cyclic systems. The second deals with statics and dynamics of a rigid body. The third practically treats of continuous distributions of matter the dynamical properties of which are determined by partial differential equations with regard to the space-coordinates. By this we include attractions, theory of the potential, spherical and other harmonic analysis, elasticity, hydrostatics, hydrodynamics and sound.

Like every other book, this one has some good features and some defects. To take one or two small instances chosen at random; it is pointed out, rightly (p. 205), that the statement that forces applied to a rigid body are sliding vectors with five coordinates is not a property of forces, but of rigid bodies. On the other hand, it would be surely better to employ the word translation for rotation-couple on p. 209. Again, on p. 404, the expression for the potential of a distant body is not nearly so convenient as the ordinary form involving $A+B+C-3I$, which is not given.

Prof. Webster assumes a fair knowledge of the calculus, but not of differential equations or of higher analysis. It would, however, appear that a fair knowledge of the geometry of x, y, and z is needed; in evidence of this need, the equation

$$\cos^2\lambda+\cos^2\mu+\cos^2\nu=1$$

appears assumed on the second page. For anyone so equipped, Prof. Webster has "attempted to provide a treatise which would in not over a year's time offer to the student an amount of knowledge of Dynamics sufficient to prepare him for the study of Mathematical Physics in general."

But we are surely justified in examining what chances the English student of physics or engineering has of taking his place beside his American and German rivals in drawing upon this store of knowledge. The hopes that might have been raised a year or two ago as to prospective reforms in mathematical teaching will be sadly dispelled by a study of recent papers set in examinations for leaving school or matriculation. In these we find the old tendency to choke off the learner of an inquiring turn of mind, the old artificial questions on solving meaningless equations and simplifying meaningless expressions, mostly fractional, in short, everything best calculated to encourage mere mental gymnastics and to destroy all power of intelligently assimilating new ideas. The training required to produce a human examination-answering machine capable of working at matriculation level and of going no further would, if directed into a right channel, enable that same learner to differentiate and integrate rational algebraic functions, to calculate the areas of their graphs, and perhaps in the third year of a college course to read this book. G. H. B.

A NATURALIST'S PHILOSOPHY.

Essays on Evolution and Design. By the late Prof. John Young. Edited, with an analysis and an introduction, by William Boyd. Pp. xiii+248. (Glasgow: James Maclehose and Sons; London: Macmillan and Co., Ltd., 1905.) Price 6*s*.

MANY who knew the late Prof. John Young as a versatile thinker and keen critic will be interested in this posthumous volume which discloses his philosophy. To a wider audience the book will appeal by its vigorous criticism of mechanistic interpretations, its protest against theories of fortuity, and its confession of faith in a cosmic plan. The author seems to have felt acutely that the scientific formulations which attempt to give a genetic description of how things have come about fall very far short of being adequate, and that in any case they are never *explanations* which will satisfy the human spirit. Prof. Young sought to show that whether we consider the fundamental concepts of matter and force, the living organism, or the mind of man, we find that the naturalistic scheme is either guilty of *petitio principii* or of that "materialism" which attempts to give a false simplicity to the facts. The principle of continuity breaks down at every point, and our only alternative to giving up scientific explanation (as so many have done) is to fall back on the idea of design, and to make appeal to "the regulating influence of plan of some sort."

To many it will appear that the bulk of the book is an *argumentum ad ignorantiam*, and that many of the failures in scientific interpretation on which the author laid an incisive finger are only partial and temporary failures. Where he found insuperable difficulties, *e.g.* in the application of the selectionist theory, others find corroboration and encouragement. But it may serve a useful purpose to have vividly pointed out some of the difficulties involved in the origin of living organisms with individualities of their own, in the evolution of many important phenomena of animal structure and function, in the rise and progress of mental life, and in the emergence of the distinctively human "ought." If we under-

stand the author aright, he believed not merely in a "cosmic plan," not merely in a "will behind phenomena," but that "processes are directed by an external power."

Prof. Young seems to have taken the evolution theory *cum grano salis*; he thought that the origin of variations is left unaccounted for, that natural selection is an over-rated factor, that it is a modal, not a causal principle, "subordinated to something other than itself," that the Lamarckian interpretation cannot be disregarded, and that far too little attention is paid by naturalists to the individuality of the organism itself. But apart from his insistence on the necessity of recognising "the regulating influence of plan of some sort," his book is critical rather than constructive. It is matter for regret that he did not live to work out the positive part of his thesis, that "many facts in various fields of inquiry point to the existence of a plan."

The value of the book is increased by an able introduction by the editor, Mr. William Boyd, who also supplies an admirable synopsis of each chapter. It is evident that the essays were not intended by Prof. Young to be given to the public in their present form, for in some parts the argument is neither accurate nor clear. Thus, in regard to Weismann's conception of the germ-plasm, the author wrote:—

"Romanes makes the difficulty more obvious by showing that Weismann's view requires us to believe that the germ plasm is independent of and unaffected by what happens to the parent. It is impossible, therefore, for acquired characters to exist, far less to be transmitted; for no variation, however favourable, can take place unless it was foreshadowed in the ancestral protoplasm. This protoplasm was the component of the first simple forms which came into being. It is immortal. On its characters depend those of its most remote descendants. Now on this view these characters must be represented by particles of some sort, certainly of some magnitude. *What is this but to declare design in its most authoritative form?*"

Still more perplexing is the comparison of the sea-urchin's pedicellariæ with young Crinoids, and the avicularіæ of Polyzoa with Brachiopods.

OUR BOOK SHELF.

Heat and Steam (Elementary). An Introductory Supplement to a Text-book of Marine Engineering for the Use of Naval Officers, &c. By Engineer-Commander Tompkins, R.N. Pp. 54. (Portsmouth: J. Griffin and Co.; London: Simpkin, Marshall and Co., Ltd., 1906.) Price 1s. 6d. net.

THE author is instructor in steam and marine engineering at the Royal Naval College, Greenwich, and has prepared a text-book on marine engineering, primarily for the use of naval officers. This text-book has reached a second edition. In connection with recent changes in the training of cadets and junior naval officers, a new syllabus of instruction in heat and steam has been issued by the Admiralty. As a consequence, Commander Tompkins has found it necessary to modify certain portions of his text-book, and has done so in the present pamphlet, which he terms an "Introductory Supplement." Young naval officers will be enabled to use this at once, in association with the text-book, and as soon as arrangements can be made the new matter is to be incorporated in the second edition.

The supplement follows the text-book in clearness and simplicity of treatment, and should be of great value to the classes for whom it has been chiefly prepared. It embraces a brief historical review of the development of steam engines; an excellent summary of the principles of thermodynamics, written in simple language; and a sketch of the applications of those principles to engine design. The work is well up to date; it contains explanations of the types of steam turbines introduced by Parsons and De Laval, and of approved types of water-tube boilers. Measurement of power, the mechanical equivalent of heat the sources and conservation of energy, and estimates of efficiency are dealt with in a manner that makes the subjects intelligible to readers possessing only moderate mathematical knowledge. Some of the illustrations are based on most recent practice, including results obtained by the cruiser *Amethyst* fitted with turbine engines, and the sister ship *Topaze* fitted with reciprocating engines. Commander Tompkins has taken great pains to meet the requirements of the readers for whom the work has been primarily undertaken, and he has succeeded. Outside the officers of the Navy, however, there are many persons who may benefit by his work, especially those who desire to understand the principles of the steam engine and whose mathematical knowledge is limited.

Atlas of Japanese Vegetation. Edited by Dr. M. Miyoshi. Sets i.–iii.; plates 1–24. (Tokyo: Z. P. Maruya and Co., Ltd., 1905.)

THESE are the first three parts of an atlas depicting various types of Japanese vegetation, and containing twenty-four plates, accompanied by an explanatory text in English and in Japanese. The plates are reproductions from photographs, and it is remarkable, considering the skill and cheapness of artistic labour in Japan, to find that the plates of the third part bear the legend "printed in Germany."

The plates are of varied interest. Those in the first part will prove attractive to owners of gardens in this country. Plate vi. is a view of a garden laid out in Japanese style, and shows a scene entirely different from the so-called Japanese garden which is often seen at great houses in England, and where there is nothing characteristically Japanese in the arrangement of the plants or in the general effect produced by the laying out of the ground. A view of an iris garden is very pretty. Mr. Miyoshi states that the Japanese have evolved nearly 400 varieties of *Iris laevigata* var. *Kaempferi*, which show marvellous diversity in the size, shape, and colour of the flowers, and even in the character of the leaves. *Prunus mume*, also figured, is a Chinese species, so long cultivated in Japan that it is now generally known as the Japanese plum, and of it there are now more than 300 distinct varieties.

The second part consists mainly of forest scenes, the most peculiar of which is one of the Japanese beech (*Fagus Sieboldi*), with a dense undergrowth of *Sasa nipponica*, a small broad-leaved bamboo. The Japanese larch, the Hondo spruce, and some other trees are also figured. The third part is of great interest, showing pictures of plants in the little-known Loochoo Islands, and of these the most curious is a scene representing *Cycas revoluta* dotted over an extensive landscape. There is also a good picture of the screw-pine, *Pandanus odoratissimus*, the leaves of which are now being made into hats by the Japanese in Formosa. AUGUSTINE HENRY.